

2.3 CONSTRUCTION ON-SITE

WAC 463-42-145 Proposal – Construction on-site. The applicant shall describe the characteristics of the construction to occur at the proposed site including the type, size, and cost of the facility; description of major components and such information as will acquaint the council with the significant features of the proposed project.

2.3.1 Project Summary/Introduction

2.3.1.1 Introduction

The Kittitas Valley Wind Power Project (“Project”) is to be constructed in central Washington’s Kittitas Valley that has long been known for its vigorous winds. The Project will be built on high open ridge tops between Ellensburg and Cle Elum at a site located about 12 miles northwest of the city of Ellensburg. A map showing the project location is presented in Section 2.1.1, ‘Project Location’. Turbines will be located on open rangeland that is zoned as Agriculture-20 and Forest and Range by Kittitas County. The Project site has been selected primarily for its energetic wind resource and its access to several sets of power transmission lines which traverse the site and have adequate capacity to allow the wind generated power to be integrated into the power grid system.

The Project is designed to provide low cost renewable electric energy to meet the growing needs of the Northwest. The Project has transmission and interconnection requests in review with the Bonneville Power Administration (BPA) and Puget Sound Energy, and is in the process of marketing the electrical energy sales into the local and regional power market consisting of municipalities, cooperatives, investor owned utilities and others.

Detailed descriptions of the types of activities required to construct the Project and the plan for managing the Project during construction and operations are contained in Section 2.14, ‘Construction Methodology’, and Section 2.13, ‘Construction Management’, respectively.

2.3.1.2 Overview

The Kittitas Valley Wind Power Project (Project) consists of several prime elements which will be constructed in consecutive phases including roads, foundations, underground and overhead electrical lines, grid interconnection facilities, one or two substations, an operations and maintenance (O&M) center and associated supporting infrastructure and facilities. Approximately 90 acres of land area will be required to accommodate the proposed power plant and related support facilities. A general site layout illustrating these key elements is contained in Exhibit 1, Project Site Layout.

The Project will consist of up to 121 wind turbines for an installed nameplate capacity of up to 200 megawatts (MW). The Project will utilize 3-bladed wind turbines on tubular steel towers each ranging from 1.3 MW to 2.5 MW (generator nameplate capacity) and with dimensions as shown in Figure 2.3.6-1. The Project Site Layout shows turbine spacing based on a 70 meter (230 ft.) rotor diameter. If, at the time of final construction design, a turbine with a larger rotor is utilized, fewer turbines will be installed along the same road pathways shown in the Site Layout with turbines spaced further apart as more fully described in Section 2.3.12, ‘Turbine Layout Variances’.

The expected service life of the facility is 20 years. Well-maintained power plants complying with industry standard practices are capable of service lives longer than 20 years, however, due to the rapid advancement in wind turbine technology, it is likely that the turbines will be replaced under a re-powering program similar to what has happened to several of the earlier wind power projects in Europe and California.

2.3.2 Roads and Civil Construction Work

Access to the various rows of turbines will be achieved via graveled access roads branching from state highways 10 and 97 and county roads Bettas and Hayward roads. The roads are designed to allow for heavy equipment to be transported to the Project and will be used throughout the life of the Project to allow access to and from the wind turbines, substations and meteorological monitoring towers. Flat areas, approximately 30 ft. by 60 feet, will be cleared, compacted and graveled as necessary adjacent to each turbine location as a crane pad to facilitate the erection of the wind turbines and towers. Parking facilities and equipment lay-down areas will be limited to a small area adjacent to the operations and maintenance center and substation.

2.3.2.1 Road Footprint

The road design has been prepared to minimize the overall disturbance footprint and avoid erosion risks. Wherever practical, existing roads have been utilized to minimize new ground disturbance, see Exhibit 2, 'Aerial Photo with Site Layout'. Approximately 26 miles of gravel road construction will be undertaken for the Project consisting of roughly 19 miles of new road and improvements to roughly 7 miles of existing roads.

Figure 2.3.2-1 Typical Wind Power Project Gravel Road



The roads will consist of a 20 feet wide compacted graveled surface. In areas of steeper grades, a cut and fill design will be implemented to keep grades below 15% and prevent erosion.

Each substation site with interconnection facilities will require approximately 2-3 acres of land area and the O&M facility, with parking, will require about 2 acres of land area. Overall, the Project will have a ground disturbance footprint of roughly 90 acres.

2.3.2.2 Erosion Control

During construction, depending on topography and soil conditions, hay bales or silt-fence type materials will be used to control erosion and sedimentation as needed. After construction is completed, the area will be returned as closely as possible to its original state. This excludes the service roads, which will remain in place for the life of the facility. On-site construction management will monitor the area for erosion and implement additional control measures if necessary. More details on storm water erosion control are contained in Section 2.10, 'Surface Water Runoff'.

2.3.3 Turbine Tower Foundations

The site conditions prevalent at the Project site provide solid subsurface conditions for the turbine foundations. A formal geotechnical investigation will be performed at each tower location with a drill rig and ground-penetrating radar to analyze soil conditions and test for voids and homogeneous ground conditions. Depending on the results of the geotechnical investigation, either spread footing type foundation, or a vertical mono-pier foundation, as shown in Figures 2.3.3-1 and 2.3.3-2 will be used. The foundation design will be tailored to suit the soil and subsurface conditions at the various turbine sites. The foundation design is certified by an experienced and qualified, state-registered structural engineer who has designed several generations of wind turbine towers and foundation systems that have proven themselves well in some of the most aggressive wind regions of the world.

Figure 2.3.3-1 Spread Footing Type Foundation



Figure 2.3.3-2 Mono-Pier Type Foundation



2.3.4 Electrical Collection System Infrastructure

Electrical power generated by the wind turbines will be transformed and collected through a network of underground and overhead cables which all terminate at the Project substation. It is most likely that only one substation will be constructed for the Project, however, it is possible that two substations be installed allowing access to both the BPA and Puget Sound Energy (PSE) systems.

Power from the wind turbines will be generated at 575 Volts to 690 Volts (V) depending on the type of wind turbine utilized for the Project. Power from the turbines is fed through a breaker panel at the turbine base inside the tower and is interconnected to a pad-mounted step-up transformer which steps the voltage up to 34.5 kilovolts (kV). The pad transformers are interconnected on the high side to underground cables that connect all of the turbines together electrically. The underground cables are installed in a trench that is typically 3-4 feet deep and runs beside the Project's roadways as shown in Figure 2.3.4-1. Due to the rocky conditions at the site, a clean fill material such as sand or fine gravel will be used to cover the cable before the native soil and rock are backfilled over the top.

Figure 2.3.4-2 shows a typical pad-mount transformer used at each wind turbine. The underground collection cables feed to larger feeder lines that run to the main substation(s) as shown schematically in Figure 2.3.4-3.

For the few short runs of overhead power lines, a fused, switch-riser pole will be used to run the cables from the underground trench to the overhead conductors. At the substation(s), the electrical power from the entire wind plant is stepped up to transmission level at 230 kV (PSE) or 287 kV (BPA) and delivered to the point(s) of interconnection.

In locations where two or more sets of underground lines converge, underground vaults and/or pad mounted switch panels will be utilized to tie the lines together into one or more sets of larger feeder conductors.

Figure 2.3.4-1 Typical Underground Cable Trench

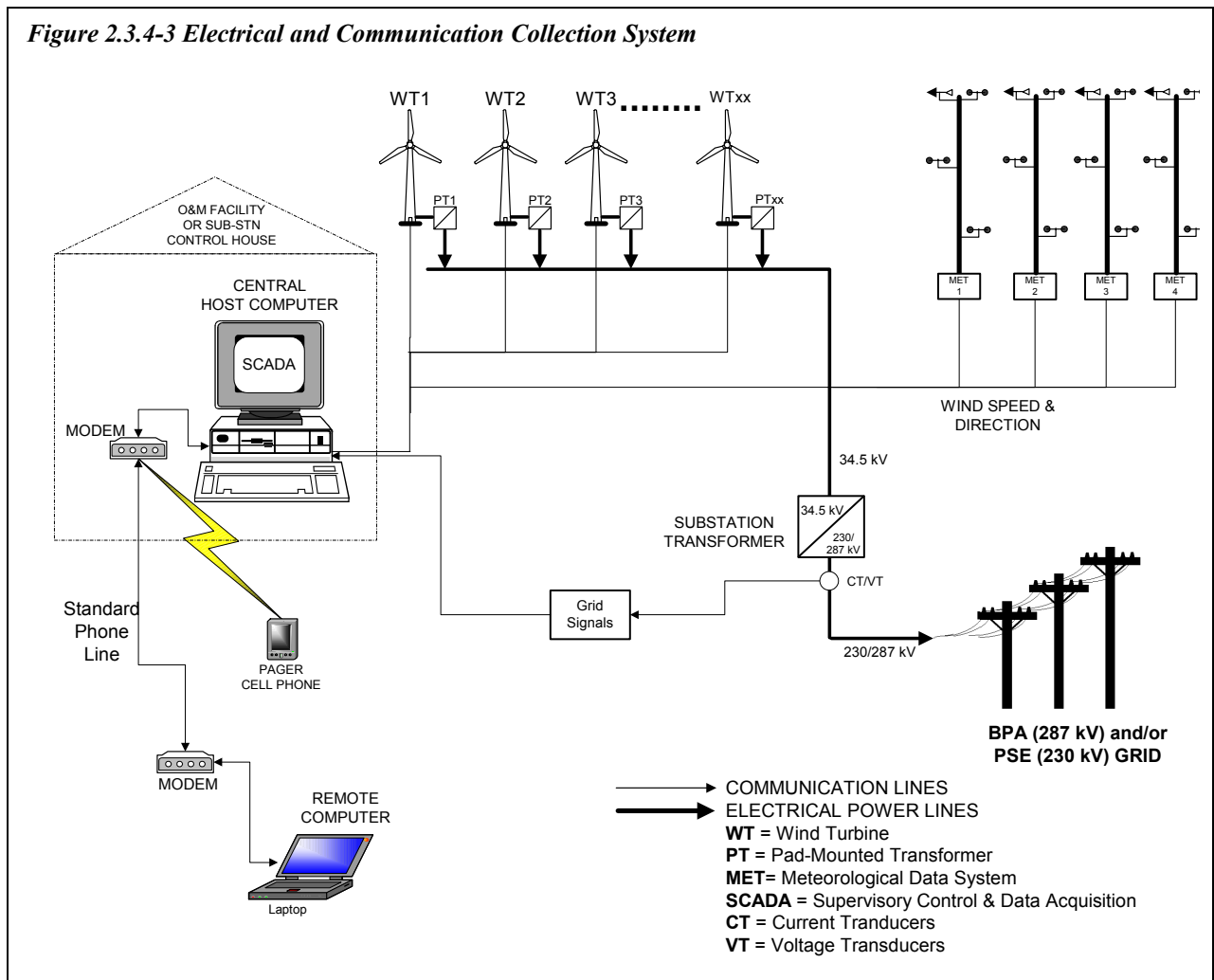


Figure 2.3.4-2 Typical Pad Mount Transformer (shown during construction before terminations landed)



The Project will require approximately 23 miles of underground and 2 miles of overhead 34.5 kV electrical power lines to collect all of the power from the turbines to terminate at the main substation(s).

Figure 2.3.4-3 Electrical and Communication Collection System



2.3.5 Interconnection Facilities and Substation

The Project would offer excellent interconnection possibilities with both Bonneville Power Administration (BPA) and Puget Sound Energy (PSE) lines traversing directly across the site. If connected to BPA's system, the Project will interconnect directly with either the Grand Coulee to Olympia or Columbia to Covington 287 kV lines. If connected to PSE's system, the Project will interconnect directly with PSE's Rocky Reach to White River 230 kV line. There is the possibility that power will be fed to both the PSE and the BPA systems resulting in the requirement for 2 substations since the lines are at two different voltages (230 kV and 287 kV). The locations of the substations are indicated on the Project Site Layout contained in Exhibit 1.

Figure 2.3.5-1 Corridor of BPA Transmission Lines Across Project Site



Power flow studies performed to evaluate the amount of transmission outlet capacity indicate that no major system upgrades will be required to either the BPA or PSE power lines to accept the power from the Project onto their grids.

The main function of the substation and interconnection facilities will be to step up the voltage from the collection lines (at 34.5 kV) to the transmission level (230 kV for PSE and 287 kV for BPA), to interconnect to the utility grid and provide fault protection. The basic elements of the substation and interconnection facilities are a control house, a bank of main transformers, outdoor breakers, relaying equipment, high voltage bus work, steel support structures, and overhead lightning suppression conductors. All of these main elements will be installed on concrete foundations that are designed for the soil conditions at the substations sites. The substations and interconnection facilities each consist of a graveled footprint area of approximately 2-3 acres a chain link perimeter fence, and an outdoor lighting system.

Figure 2.3.5-2 Typical Substation



A typical one-line diagram of a substation and interconnect system which would be used as a preliminary outline for the Project is included in Exhibit 3. Final adjustment to the substation and interconnect are generally made during design review with the utility and their system protection engineers to accommodate for conditions on the grid at the time of construction.

2.3.6 Wind Turbine Generators and Towers

Several wind turbine generators (WTGs) are under evaluation for the Project. Based on these evaluations, a number of wind turbine vendors have been pre-qualified to supply equipment for the Project including GE Wind Energy, NEG-Micon, Vestas, Nordex, Bonus, and Gamesa Eolica. The Project will consist of up to 150 wind turbines for an installed nameplate capacity of up to 205 megawatts (MW). The Project will implement 3-bladed wind turbines on tubular steel towers each ranging in size from 1.3 MW to 2.5 MW (generator nameplate capacity) and with dimensions as shown in Figure 2.3.6-1.

The pre-qualified wind turbines all have a minimum design life of 20 years under extreme high wind and high turbulence conditions. Based on the lower turbulence intensities and moderate wind speeds that have been measured on the Project site, it is likely that the original WTGs will

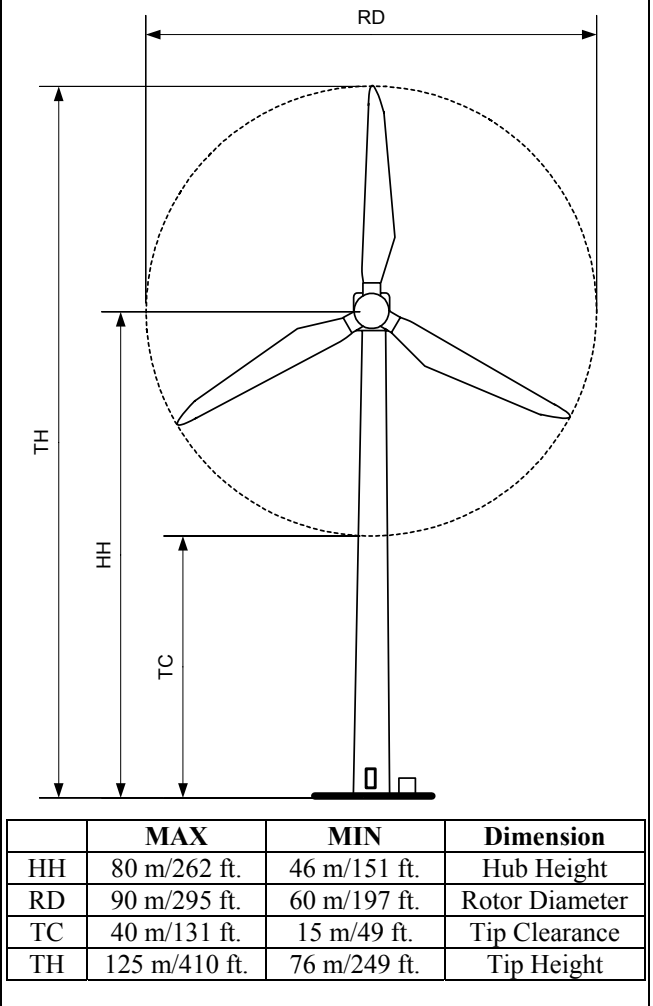
operate well into their third decade before a retrofit or replacement program is implemented.

Figure 2.3.6-2 Typical Modern WTG



nacelle. A nacelle ladder extends from the machine bed to the tower top platform allowing

Figure 2.3.6-1 Wind Turbine Dimensions



2.3.6.1 Wind Turbine Basic Configuration

Wind Turbines consist of 3 main physical components that are assembled and erected during construction: the tower, the nacelle (machine house) and the rotor (3-blades).

2.3.6.1.1 Tower

The WTG tower is a tubular conical steel structure that is manufactured in multiple sections depending on the tower height. Towers for the Project will be fabricated, delivered and erected in 2 to 3 sections. A service platform at the top of each section allows for access to the tower connecting bolts for routine inspection. An internal ladder runs to the top platform of the tower just below the

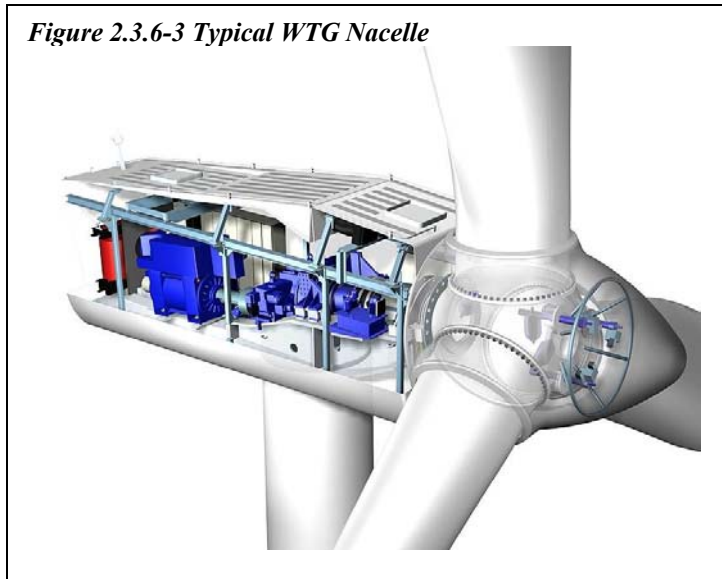
nacelle access independent of its orientation. The tower is equipped with interior lighting and a safety glide cable alongside the ladder.

The tower design is certified by experienced and qualified structural engineers who have designed several generations of turbine towers that have proven themselves well in some of the most aggressive wind regions of the world. The towers and foundations are designed for a survival gust wind speed of 90+ mph with the blades pitched in their most vulnerable position. For the cold-weather winter conditions on the Project site, special material specifications are set to ensure that materials do not go below the brittle transition temperature.

2.3.6.1.2 Nacelle

Figure 2.3.6-3 shows the general arrangement of a typical nacelle that houses the main mechanical components of the WTG. The nacelle consists of a robust machine platform mounted on a roller bearing sliding yaw ring that allows it to rotate (yaw) to keep the turbine pointed into the wind to maximize energy capture. A wind vane and anemometer are mounted at the rear of the nacelle to signal the controller with wind speed and direction information.

Figure 2.3.6-3 Typical WTG Nacelle



The main components inside the nacelle are the drive train, a gearbox and the generator. On some turbines, the step-up transformer is situated at the rear of the nacelle that eliminates the need for a pad-mounted transformer at the base of the tower.

The nacelle is housed by a fully enclosed steel reinforced fiberglass shell that protects internal machinery from the environment and dampens noise emissions. The shroud is designed to allow for adequate ventilation to cool internal machinery such as the gearbox and generator.

2.3.6.1.3 Drive Train

The rotor blades are all bolted to a central hub. The hub is bolted to the main shaft on a large flange at the front of the nacelle. The main shaft is independently supported by the main bearing at the front of the nacelle. The rotor transmits torque to the main shaft that is coupled to the gearbox. The gearbox increases the rotational speed of the high speed shaft that drives the generator at 1200-1800 RPM to provide electrical power at 60 Hertz (Hz).

2.3.6.1.4 Rotor Blades

Modern WTGs have 3-bladed rotors that range in span from 200 to 300 feet in diameter. The rotor blades turn quite slowly at about 20-25 RPM resulting in a graceful appearance during operation. The rotor blades are typically made from a glass-reinforced polyester composite similar to that used in the marine industry for sophisticated racing hulls. Much of the design and materials experience comes from both the marine and aerospace industries and has been developed and tuned for wind turbines over the past 25 years. The blades are non-metallic, but are equipped with a sophisticated lightning suppression system that is defined in detail in Section 2.3.6.1.11, 'Lightning Protection System'.

Figure 2.3.6-4 Rotor Assembly



2.3.6.1.5 Turbine Control Systems

Wind turbines are equipped with sophisticated computer control systems which are constantly monitoring variables such as wind speed and direction, air and machine temperatures, electrical voltages, currents, vibrations, blade pitch and yaw angles, etc. The main functions of the control system include nacelle operations as well as power operations. Generally, nacelle functions include yawing the nacelle into the wind, pitching the blades, and applying the brakes if necessary. Power operations controlled at the bus cabinet inside the base of the tower include operations of the main breakers to engage the generator with the grid as well as control of ancillary breakers and systems. The control system is always running and ensures that the machines are operating efficiently and safely.

2.3.6.1.6 Central SCADA System

Each turbine is connected to a central Supervisory Control and Data Acquisition (SCADA) System as shown schematically in Figure 2.3.4-3. The SCADA system allows for remote control and monitoring of individual turbines and the wind plant as a whole from both the central host computer or from a remote PC. In the event of faults, the SCADA system can also send signals to a fax, pager or cell phone to alert operations staff.

2.3.6.1.7 Safety Systems

All turbines are designed with several levels of built-in safety and comply with the codes set-forth by European standards as well as those of OSHA and ANSI.

2.3.6.1.8 Braking Systems

The turbines are equipped with two fully independent braking systems that can stop the rotor either acting together or independently. The braking system is designed to be fail-safe, allowing the rotor to be brought to a halt under all foreseeable conditions. The system consists of aerodynamic braking by the rotor blades and by a separate hydraulic disc brake system. Both

braking systems operate independently such that if there is a fault with one, the other can still bring the turbine to a halt. Brake pads on the disc brake system are spring loaded against the disc and power is required keep the pads away from the disc. If power is lost, the brakes will be mechanically activated immediately. The aerodynamic braking system is also configured such that if power is lost it will be activated immediately using back-up battery power or the nitrogen accumulators on the hydraulic system, depending on the turbine's design.

After an emergency stop is executed, remote restarting is not possible. The turbine must be inspected in-person and the stop-fault must be reset manually before automatic operation will be re-activated.

The turbines are also equipped with a parking brake that is generally used to “park” the rotor while maintenance routines or inspections that require a stationary rotor are performed.

2.3.6.1.9 Built-in Fire Safety

Each turbine's nacelle is equipped with an internal fire detection system with sensors located in the nacelle as well as at the tower base. The fire detection system is interfaced with the main controller and the central SCADA system. In the event of a fire fault, the turbine is immediately halted and an alarm condition is activated in the control system that can send a page or message to a cell phone of the on-call operators and/or the local fire district as required.

2.3.6.1.10 Climbing Safety

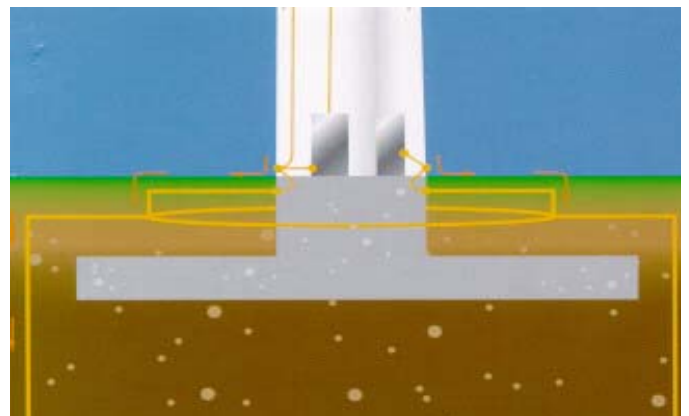
Normal access to the nacelle is accomplished with a ladder inside the tower. Standard tower hardware includes equipment for safe ladder climbing including lanyards and safety belts for service personnel. All internal ladders and maintenance areas inside the tower and nacelle are equipped with safety provisions for securing lifelines and safety belts and conform to or exceed ANSI 14.3-1974 (Safety Requirements for Ladders).

2.3.6.1.11 Lightning Protection System

The WTGs are equipped with an engineered lightning protection system that connects the blades, nacelle, and tower to the earthing system at the base of the tower.

As the rotor blades are nonmetallic, they normally do not act well as a discharge path for lightning, however, as the highest point of the turbine, the blades sometimes provide the path of least resistance for a lightning strike. In order to protect the blades, they are constructed with an internal copper conductor extending from the blade tip down to the rotor hub which is connected to the main shaft and establishes a path through the gearbox, nacelle bed frame etc. to the tower base right down to the grounding system embedded underground. An additional lightning rod extends above the wind vane and anemometer at the rear of the nacelle. Both the rear lightning rod and blades have conductive paths to the nacelle bed frame

Figure 2.3.6-6 Turbine Earthing System at Tower Base



that in turn connects to the tower. The tower base is connected to the earthing system at diametrically opposed points.

Figure 2.3.6-5 shows the general arrangement of the earthing system with respect to the tower and foundation. The earthing system consists of a copper ring conductor connected to earthing rods driven down into the ground at diametrically opposed points outside of the foundation. The earthing system, with a resistance of less than 2 Ohms, provides a firm grounding path to divert harmful stray surge voltages away from the turbine.

The controllers and communication interfaces to the wind farm central control system are through fiber optic cables and optical signal conversion systems protecting these systems from stray surges.

Figure 2.3.6-5 WTG Lightning Diversion Paths



2.3.7 Operations and Maintenance (O&M) Facility

An O&M facility is planned to be located near the corner of state Highway 97 and Bettas Road as indicated on the Project Site Layout in Exhibit 1. The O&M Facility will include a main building with offices, spare parts storage, restrooms, a shop area, outdoor parking facilities, a turn around area for larger vehicles, outdoor lighting and a gated access with partial or full perimeter fencing. The O&M building will have a foundation footprint of approximately 50 ft. by 100 ft. The O&M facility area will be leveled and graded and will serve as a central base of construction operations with up to 8 temporary office trailers and portable toilets parked in place during the construction phase of approximately one year.

2.3.8 Meteorological Monitoring Station Towers

The Project design includes four permanent meteorological (met) towers that are fitted with multiple sensors to track and monitor wind speed and direction and temperatures. The met towers will be connected to the wind plant's central SCADA system as shown in figure 2.3.4-3. The permanent towers will consist of a central lattice structure supported by 3-4 sets of guy wires and will be as tall as the hub height (HH) of the WTGs as shown in Figure 2.3.6-1 which is 46-80m (151-262 ft.).

2.3.9 Feasibility of Technology

The Project will utilize proven utility grade equipment with a minimum design life of 20 years. The most vulnerable equipment are the wear and tear components of the wind turbines. The Project will utilize only well-proven designs that have been approved by reputable third party testing agencies. Modern wind turbines of the type being proposed for the Project have been developed over the past 25 years and have been proven over several generations of equipment. The basic configuration of the 3-bladed up-wind

turbine is the best proven and understood turbine configuration available in the industry and the vast majority of all new wind power generation facilities planned, or under construction in the world utilize this technology. The wind turbine technology used for the design of the Project has proven to be very reliable, efficient, and lower in electrical energy production cost than other commercially available wind power technologies.

Over the past 25-30 years, more than 56,000 wind turbines have been installed around the world for an installed nameplate capacity of about 25,000 MW. More than 18,000 wind turbines (about 4,600 MW) are installed in the USA and there are more than 300 units (200 MW) of wind turbines operating in the state of Washington, near Walla Walla and Pasco.

2.3.10 Wind Power Plant Design Life

Wind Power Projects are designed to meet general utility grade standards as well as a number of other stringent codes and requirements. As a result, the design life of all of the major equipment such as the turbines, transformers, substation and supporting plant infrastructure are all designed to be at least 20 years. Based on the site conditions, it is expected that the proposed turbine technology will continue to perform well into its third decade of operation.

Figure 2.3.8-1 Met Tower



2.3.10.1 Equipment Selection

A very rigorous approach has been taken in an effort to pre-qualify all key equipment suppliers for the Project, especially the wind turbines. Only equipment that has been proven as utility grade with the main emphasis on safety, reliability and competitive pricing will be utilized. This results in a project that delivers energy safely and reliably at the most competitive cost possible over the long haul.

Various factors are taken into consideration in selecting the best technology to implement for a given project. First and foremost are the requirements of the customer. Most utility customers are concerned with purchasing the least expensive available energy with the least amount of integration costs to the transmission system.

2.3.10.2 Wind Turbine Type Certification

European manufacturers, for many years, have been required to meet rigid standards verifying their design criteria, operational characteristics, supervision of construction, transportation, erection, commissioning, testing and servicing. In Europe, Germanischer Lloyd (GL), Det Norske Veritas (DNV), Wind Test GmbH, and Risø (Denmark) are independent testing laboratories, which administer regulations for the design, approval, and certification of wind energy conversion systems. There are no well-established testing agencies in the US that offer the amount of experience, scrutiny and know-how as the European groups. For this reason, the Project will implement turbine technology that, as a minimum, complies with the European standards.

The testing processes involved in the approval of design documentation, include safety and control system concepts, static and dynamic load assumptions, and associated load case

definitions. Once approved, specific components, such as blades, drive trains (hubs, gearing, bearings and generators etc.) safety systems, towers, yaw systems, foundations, electrical installations, will be reviewed and approved according to minimum standards established by these testing laboratories. In addition to operating characteristics and design features, the testing groups review construction supervision procedures, including materials testing, QA reports and procedures, corrosion protection, and others. They also review and set standards for supervision during the transportation, erection and commissioning of the turbines.

Operational testing performed by the laboratories includes measurement of power curves, noise emissions, as well as loads and stresses including wind loads imposed on the tower, foundation, drive train, blades, nacelle frame, power quality, etc. Test data are evaluated for plausibility, and compared with the original calculations and mathematical models used for the design.

Neither Germanischer Lloyd nor Risø, nor DNV will issue its certification unless the turbine design has met minimum design standards and performance levels, both calculated and measured. The approval process also applies to the manufacturers' processes and procedures through ISO 9001.

Due to this arduous approval process, European-designed wind turbines have proven to be the most reliable wind energy systems over at least the past decade. In Europe, certification pursuant to these standards is mandatory for both permitting and financing. Partly due to these verification programs, lenders in Europe view wind energy equipment in the same way lenders in the United States might view the purchase of heavy construction equipment.

The Project will implement only turbines that have achieved type certification by a reputable and experienced third party verification institute such as DNV, GL, Risø, or WindTest and demonstrate a design life of at least 20 years.

2.3.11 Reliability/Availability

2.3.11.1 Facility Availability

The Kittitas Valley Wind Power Project will utilize heavy-duty, utility grade equipment. Other wind power projects with similar configurations and grades of high quality, reliable and proven equipment have demonstrated operating availability figures in the mid to high-90 range over the past decade. The availability of wind power projects rivals that of conventional power plants that are generally in the low-90 to mid-90 range.

The Project is expected to operate consistently in the mid-90 to high-90 percent availability range. Facility unavailability is due to several factors and generally is classified as scheduled (planned) or unscheduled (forced) outages.

2.3.11.2 Scheduled Maintenance - Planned Outages

The amount of downtime due to scheduled maintenance is generally very predictable from year to year. The proposed project-operating plan includes a planned outage schedule cycle that consists of WTG inspections and maintenance after the first 3 months of operation, a break-in diagnostic inspection, and subsequent services every 6 months. The 6-month service routines generally take a WTG off-line for just one day. The 6-month routines are very rigorous and consist of inspections and testing of all safety systems, inspection of wear-and-tear components such as

seals, bearings, bushings, etc., lubrication of the mechanical systems, electronic diagnostics on the control systems, pre-tension verification of mechanical fasteners and overall inspection of the structural components of the WTGs. Blades are inspected and, if heavily soiled, rinsed once per year to maintain overall aerodynamic efficiency. Blade washing is not anticipated as a requirement for the Project since the fall and spring rains will remove most if not all blade soiling.

Electrical equipment such as breakers, relays, transformers, etc. generally require weekly visual inspections, which does not affect overall availability, and testing or calibrations every 1-3 years which may force outages.

To the extent practical, the short-term off-line routine maintenance procedures are coordinated with periods of little or no generation as to minimize the impact to the amount of overall generation.

2.3.11.3 Unscheduled Maintenance - Forced Outages

Historically, modern wind power projects operate with availabilities in the 95% to 99% range. Several components and systems of an individual wind turbine can be responsible for forced, non-routine outages such as the mechanical, electrical or computer controls. Most of the outages are from auxiliaries and controls and not the heavy rotating machinery. Most developing heavy machinery failures are found prior to failure, during the frequent inspections, so that the failing part is replaced prior to complete failure.

Although the newer control systems have added a high level of detection and diagnostic capability, they normally require frequent minor adjustments in the first few months of operation. As a result availabilities of a wind power project are generally lower in the first few months until they are fully tuned. Once a wind plant is properly tuned, unplanned outages are generally very rare and downtime is generally limited to the routine service schedule.

The O&M facility is always stocked with sufficient spare parts to support high levels of availability during operation. The modular design of modern wind turbines results in the majority of parts being “quick-change” in configuration, especially in the electrical and control systems. This modularity and the fact that all of the turbines are identical allows for the swapping of components quickly between turbines to quickly determine root causes of failures even if the correct spare part is not readily available in the O&M building. As part of their supply agreements, almost all major turbine equipment vendors guarantee the availability of spare parts for 20 years.

2.3.12 Turbine Site Layout Variances

The wind turbines will be installed along the roadways as shown in Exhibit 1, ‘Project Site Layout’. The layout design is based on wind turbines with a rotor diameter of 70 meters. Due to the fact that there are variances that are discovered at the time of performing a final site survey of the exact locations of the Project facilities, some flexibility in determining the facility locations is required to allow for in-field practicalities. Generally, it will not be necessary to relocate roads significantly from their currently shown location on the Site Layout, however, the exact location of the turbines along the planned roadways may need to be altered from the shown plan in Exhibit 1 due to a number of factors including:

- The results of the geotechnical investigations at each surveyed turbine location may reveal underground voids or fault line locations. In this case, the turbine location may need to be altered or eliminated;
- The final on site field survey with the meteorologists may dictate that turbines be spaced slightly closer together in some areas and further apart in other areas;
- If, at the time of construction, a turbine with a larger rotor diameter is to be used, the turbine spacing will be increased and the overall number of turbines would be reduced;
- The final field measurement test surveys of communication microwave paths may require that some turbine locations be adjusted slightly to avoid line-of-sight interferences.

With the range of turbines that are proposed for use on the Project with rotor diameters ranging from 60 to 90 meters (197 to 295 feet), turbine locations would not vary from their shown locations by more than 105 meters (350 feet). Any adjustments to final turbine tower locations would not bring them any closer to public roads, power lines, property lines of non-participating landowners or residences where the setbacks shown currently shown on the Project Site Layout would be not be reduced.

2.3.13 Project Cost Estimate

The total project costs, including the equipment, construction, development, financing, legal, study costs etc. is estimated to be roughly \$1,000 per kilowatt of installed nameplate capacity. Therefore, for a project size of 182 MW, the Project will cost approximately \$182,000,000.